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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/604,026

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Jeffrey P. Gambino

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EXAMINER

PAREKH, NITIN

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 01/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/604,026

Applicant(s)

GAMBINO ET AL.

Examiner

Nitin Parekh

Art Unit

2811

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 October 2004.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 10-14 and 25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 10-14 and 25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 June 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 25 and 11-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Dubin (US Pat. Application Pub. 2004/0108217).

Regarding claims 25 and 13, Dubin discloses an interconnect structure/IS (Fig. 3)

formed on a substrate (102 in Fig. 3), the structure comprising:

- a first layer of a first dielectric material having a first one conductor embedded therein (104 and 112 respectively in Fig. 3), the first conductor having a top surface coplanar with a top surface of the first layer of the dielectric material
- a second layer of a second dielectric material overlying the first layer of dielectric material and having one second conductor embedded therein (104' and 112' respectively in Fig. 3)
- the second conductor comprising copper (112' in Fig. 3; section 0028) and having a first/bottom portion and a second/top portion wherein the first/bottom

portion is in electrical contact with the first conductor, the second/top portion overlying and in electrical contact with the first/ bottom portion (see damascene structure in Fig. 3), the second/top portion having a lateral dimension/extent greater than that of the first/bottom portion

- the second/top portion having a top surface coplanar with a top surface of the second layer of dielectric material (see Fig. 3), and
- a conductive liner/barrier structure (CLS) comprising a barrier/first conductive liner being disposed on an underside and sidewalls of the second conductor (see 108 in Fig. 3), the first barrier/conductive liner being formed of a conventional material such as titanium, tantalum, etc. (section 0021)

(Fig. 3; section 0029; Fig. 1-3; sections 0015-0031).

Dubin further teaches the CLS comprising a multiple conductive layers including a second liner/seed layer (see 110 in Fig. 1e; sections 0022) having the respective conductor embedded such that the second liner/seed layer is located underside and on the sidewalls of the first/bottom portion of the respective/second conductor.

Furthermore, the second liner/seed layer is formed of one or more conductive layers (section 0022).

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Regarding claims 11 and 12, Dubin teaches the entire structure as applied to claim 25 above, wherein Dubin further teaches the first and second dielectric layers being formed from a variety of material and having layers or laminations with different thickness including silicon oxide, organic or inorganic dielectric, etc. to provide the desired insulation/dielectric properties (sections 0018 and 0019).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin (US Pat. Application Pub. 2004/0108217) in view of Jain (US Pat. 5821168).

Regarding claim 10, Dubin teaches the entire structure as applied to claim 25 above, except a hardmask layer overlying the second layer of dielectric material wherein the second portion of the second conductor has a top surface being coplanar with a top surface of the hardmask layer.

Jain teaches a dual-damascene interconnect structure (/DIS) where a barrier/hardmask layer is formed above a dielectric /second dielectric layer (see 56 and

54 respectively in Fig. 9) such that a second portion of a conductor/second conductor has a top surface coplanar with the top surface of the barrier/hardmask layer (see Fig. 9; Col. 3, line 25- Col. 5, line 53).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the hardmask layer overlying the second layer of dielectric material wherein the second portion of the second conductor has a top surface being coplanar with the top surface of the hardmask layer as taught by Jain so that the planarization/etch back and the top surface planarity/uniformity can be improved in Dubin's IS.

5. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin (US Pat. Application Pub. 2004/0108217) in view of Omura (US Pat. 6028362).

Regarding claim 14, Dubin teaches the entire structure as applied to claim 25 above, except the second liner comprising a material selected from the group consisting of titanium nitride (TiN), tantalum (Ta), tantalum nitride (TaN) and tungsten (W).

Omura teaches a DIS having a CLS comprising a variety of barrier layers/conductive liners/adhesion layers (see 50, 54, etc. Fig. 9-11) to improve the adhesion/barrier for the metallization where the conductive liner/seed layer underneath copper metallization (see 54 in Fig. 10) comprises a variety of conventional material including Ti, TiN, TiW, etc. (Col. 10, lines 42-56; Col. 9-11; Col. 18 and 19).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the second liner comprising a material selected from the group consisting of titanium nitride (TiN), tantalum (Ta), tantalum nitride (TaN) and tungsten (W) as taught by Omura so that the desired adhesion/barrier properties can be achieved and the reliability can be improved Dubin's IS.

Response to Arguments

6. Applicant's arguments filed on 10-29-04 have been fully considered but they are not persuasive.

A. Applicant contends that Fig. 1e in Dubin fails to disclose only one liner being disposed on the underside and sidewalls of the second portion of the conductor.

However, the limitations as recited in the new claim 25, include "a first conductive liner disposed on an underside and sidewalls of the second conductor". The above limitations do not recite "only one liner being disposed on the underside and sidewalls of the second portion of the conductor".

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9318.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

NP

12-27-04



NITIN PAREKH

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800